

# Assessment of the impact of a clinical and health services research call in Catalonia

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This article presents the ex-post assessment of a program of clinical and health services research and the evaluation of the social impact. The Catalan Agency for Health Information, Assessment, and Quality (CAHIAQ) promotes a biannual open, public, competitive extramural research call to conduct non-commercial clinical and health services research. Its aim is to address local needs of research (knowledge gaps) and to assess the implementation of innovation. Approximately 5.8 million Euros have been allocated to the call. To meet the Agency's mission, a periodical 'call for expressions of interest' and topic prioritization is organized prior to the research call. The awarded projects are submitted to an ex-ante, ongoing, and ex-post assessment. Impact assessment of the research call on advancing knowledge and healthcare decision making is based on the Canadian Academy of Health Sciences framework (Panel on Return on Investment in Health Research, 2009). The methods used include bibliometric analysis, surveys to researchers and decision-makers, and a more in-depth case study of translation pathways. This includes a crossover of cases from 1996 to 2004. Some results are compared against other international health services research calls. The conclusion is that local agencies can significantly contribute to fill knowledge gaps in a specific context. Assessment of the complete research cycle provides opportunities for improving the entire research process (identification of knowledge needs, call for proposals, funding allocation, research completion, subsequent impact). Specifically, assessment of the different types of impact of research development on knowledge generation and decision making closes the evaluation cycle fulfilling the Agency's mission.

**Keywords:** *payback model; research impact assessment; informed decision-making; funding agency; clinical and health services research; topic prioritization.*

## Introduction

There is within the health sciences enterprise a type of research oriented to help clinicians and patients change behaviours and make better informed choices; improve healthcare quality; and ultimately lead to a more effective

and efficient healthcare. This is the so-called second block of translational research (T2) (Woolf 2008). Within this, the focus of health services research is to ensure that new treatments and research knowledge actually reach the patients and populations for whom they are intended

and that these are correctly implemented. Despite the clear link with value for money, in financial terms, health services research is argued to remain a neglected field within the big biomedical research enterprise (Dorsey et al., 2010). In some countries, the ministries or departments of health promote such research within and for the system as a way to promote better quality and results (e.g. National Institute for Health Research in the UK). In the past couple of years, several international organizations such as the WHO (World Health Organisation) have promoted mottos like ‘no health without research’ or ‘better research for better health’, which are certainly aimed at advocating T2 type research, its transferability and/or social impact in practice.

At the same time, scepticism towards unrestricted and unregulated research activities and technology development is growing. Even in lay media (Carmichael and Begley, 2011), doubts are expressed about the extent to which the present rate of research expenditure and scientific development contributes to a better health of the population. Both the USA (Moses and Martin, 2011) and Europe (European Science Foundation, 2011) propose a more judicious guidance and planning of research policy and its implementation, and also a wider knowledge of its social payback. ‘No research without evaluation’ might soon become a pre-condition at all levels.

The need for evaluating the impact that research has on key social issues such as knowledge, decision making as well as on health and economic benefits, has stimulated a whole array of evaluative frameworks and practices. Such evaluation of the social impact of the research process may be articulated within the mission of evaluation agencies. Those agencies serving local or regional areas may play a specific role in detecting or identifying local research needs and also in assessing how research has contributed to their fulfilment by assessing its social impact.

This article reports the assessment experience of a funding program to conduct clinical and health services research promoted in Spain by the Catalan Agency for Health Information, Assessment, and Quality (hereinafter the Agency<sup>1</sup>). In 2000, despite the budget increase of up to 1 million Euros per call, in 2004 health services research represented a small amount of the Catalan public health-related expenditure. In 2008, the Agency’s non-commercial clinical and health services research accounted for 4% of the overall public support to biomedical research centres from the Catalan Ministry of Health. Besides European and Spanish sources of funding, for many years the Agency’s call was the most prominent regional source of public funding for research projects (OECD 2010). Without attempting to make comparisons, the relevant fact remains that the Agency led the way to the preferential dedication of grants to two types of biomedical research which might have otherwise tended to be neglected: clinical

research driven by investigators and health services research.

The mission of this research program was ‘to fill local knowledge gaps and inform clinical and healthcare decision-makers’. To this end, a process of research topic identification and priority-setting (Berra et al., 2010) was designed and implemented prior to every research call. Furthermore, a structured process of *ex-ante* assessment of research projects and their follow-up was adopted, including the dissemination of results. Finally, the assessment cycle was closed with a comprehensive assessment of its impact on advancing knowledge and improving decision-making process (ex-post assessment) (Adam et al., 2010; Solans et al., 2010; Adam et al., 2011a). The impact assessment study was carried out to be accountable to society on the achievements with regard to the call’s mission, and to advocate for health services research and investigators-driven clinical research as a means to serve local decision-makers needs.

This article presents the methods and results of the impact assessment of the projects awarded between 1996 and 2004 through the Agency’s call for clinical and health services research.

## Context

The Agency was created in 1994 as a public company of the Catalan Health Service (CHS). It has a Board of Directors (BoDs) and a Scientific Advisory Committee (SAC). The Catalan government appointed the members of the BoD, chosen among relevant prestigious and independent personalities in the health care field. At the same time, the BoD elected the members of SAC among healthcare professionals from different disciplines. The CHS, the public body that finances the healthcare for the Catalan population (7 million), as part of the decentralized Spanish Health System (García-Armesto et al., 2010), is based on taxes collected by the central government and provides free-of-charge universal coverage for all the population. Specific, although not exclusive, of the Catalan Health System is the split between the single purchaser of services (CHS) and healthcare providers that can either be public or private. Additionally, around 20–25% of the Catalan population has an additional private health insurance coverage plan. In Catalonia, there is a long tradition of biomedical research which relies on the strength of its publicly financed healthcare system and academic medical centres (OECD 2010).

In order to accomplish the function of translational research, the Agency amended its by-laws and incorporated the promotion of non-commercial (i.e. not promoted by the pharmaceutical and medical devices industry) clinical and health services research to its goals through a program of extramural research grants so as to fill the health and knowledge needs of the Catalan population and the CHS (Solà-Morales and Granados, 2009).

A total of 7 research calls, 1 every 2 years, have been carried out by the Agency since 1996. Almost 6 million Euros have been distributed.

By 2002, it became clear that assessing the impact of the research promoted by the Agency and its appropriateness to the local healthcare context were pertinent tasks for the Agency. This was the origin of the Social Impact of Research ('*Impacte Social de la Recerca*'—ISOR—in Catalan) project, the objective of which is to assess the social impact of the research sponsored by the Agency as an institution accountable to the citizens and to the CHS. As a means to close the assessment cycle in relation to the Agency's mission, the levels of impact that were considered in the assessment studies were: impact on advancing knowledge and impact on decision-making.

## Methods

To meet the Agency's mission, a method of topic identification and priority-setting was adopted (Adam et al., 2010). It includes the public announcement of the 'call for topics or expression of interest', distributed to more than 5,000 healthcare stake-holders and the assessment of the topics proposed by two independent reviewers using a validated questionnaire (Berra et al., 2010). Project assessment consists of a double peer-review process, beginning with a blind assessment of the project and followed by the assessment of the research team. In the last stage, the results are publicly released. Awarded projects are also assessed every year with a progress report that measures achievements, results, and any modifications made to the work plan (ongoing assessment). Continued funding (in the form of payments) is dependent on this assessment. After 5 years, the Agency organizes a public presentation of achievements of the projects and produces a report listing the outputs and summarizing the findings.

The conceptual framework used for assessing research impact is the Return of Investment (ROI) model from the Canadian Academy of Health Sciences (CAHS) (Panel on the return on investments in health research, 2010; Frank and Nason, 2009), which uses a multifaceted methodology with different approaches depending on the type of impact sought. This model is a revised or updated version of the Payback Model (Hanney et al., 2004), authored by the HERG Group (Health Economics Research Group) from Brunel University. Among others, the ROI CAHS model has the advantage that includes the concept of 'reach' (Montague and Porteous, 2012), that is, the 'target that a given program or organization is intended to influence, including individuals and organizations, clients, partners, and other stakeholders'. In the case of the Agency's call, as stated earlier, the reach is 'to fill local knowledge gaps and inform clinical and healthcare decision-makers'. Within the ROI CAHS model, five

impact levels are considered, two of which are discussed in this article, namely impact on advancing knowledge and impact on informed decision-making. The model also includes the logic of interrelationships (conceived by the payback model authors) between research outputs and implementation of research findings at the stages in which decisions are taken, allowing for a variety of possible impacts (final outcome). Furthermore, the ROI model benefits from a rich set of quantitative indicators ordered according to impact category. All completed projects from 1996 to 2004 were included in the different studies of impact assessment of the research calls. The assessment was carried in 2010 and 2011.

Assessing the research impact in advancing knowledge entailed three methods with cross over of cases between methodologies. First, a descriptive study of data obtained from the projects records and a questionnaire sent to the principal investigators (PIs). Second, a search of outputs in bibliographic databases such as Web of Science (WOS) from ISI-Reuters and *Índice Médico Español* (IME, Spanish medical bibliographic database) was conducted. Third, a qualitative case study of an intentional sample of projects that were ranked as top-ten most cited articles in at least one bibliometric databases (WOS and Google Scholar) and in the ranking of cumulative impact factor of the journals where the articles derived from the projects were published (Adam et al., 2010).

The assessment of the research impact on informed decision-making was first carried out using a descriptive study of data obtained from a questionnaire sent to the PIs (Solans et al., 2010). Decision making pathways were further analyzed in projects on respiratory diseases by performing semi-structured individual interviews to relevant researchers (face-to-face) and decision-makers (by telephone) identified through key informants. Respiratory diseases were selected as a study sample for convenience reasons, as they included a minimum number of projects. Subsequently, content analyses of the interviews were performed and the results were revised and verified via triangulation with other experts (Adam et al., 2011a).

Results from the Agency call were contrasted with published peer-reviewed studies of impact assessment of similar research programs. A search in Google Scholar was made in order to find documents related to the impact assessment of funding programs oriented to health services research and health technology assessment. The documents found were: a study of the Dutch ZonMV program (Oortwijn et al., 2008); a study of the England's National Health Service R&D Health Technology Assessment program (Hanney et al., 2007; Raftery et al., 2009); and a study on a publicly funded Health and Health Services Research Fund (HHSRF) of Hong Kong (Kwan et al., 2007). The Supplementary data summarize the main features of each call and impact assessment study. These comparisons are not meant to be comprehensive and therefore they ought to be interpreted with caution.

**Table 1.** Description of different characteristics of the Agency's research calls

Agency calls	Topic priority-setting process		Projects assessment				
	Topics ( <i>n</i> )		Projects ( <i>n</i> )			Funding (€)	
	Submitted	Selected	Submitted	Granted	Completed	Total per call	Average per project
1996	–	17	71	18	18	510,860	33,056
1998	205	20	51	19	17	540,911	27,319
2000	116	30	120	25	24	841,417	30,050
2002	216	35	103	25	24	841,417	35,593
2004	190	30	176	22	21	1,021,721	47,000
2006	210	29	99	18	15	1,021,721	51,310
2008	241	20	121	14	0	1,021,214	73,670
Total	1,178	181	741	141 <sup>a</sup>	116	5,799,261	–

Note: <sup>a</sup>Corresponding to 131 topics, that is, more than one project can address the same topic (not identical projects).

## Results

Since the 1996 call, a total of 181 topics were prioritized among 1,178 topic submitted (Table 1). As a result of the peer-review evaluation 141 out of 741 (19%) projects submitted were funded (between 12% and 37% in the different calls) on the basis of their methodological quality and relevance.

### Outputs and impact in advancing knowledge

The study (Adam et al., 2010) comprised 92 completed projects, and the bibliographic database search was carried out during the first semester of 2009. As an indication of research activity, the PIs declared a total production of 858 documents, of which 180 were original articles and 94 other kind of scientific publications such as reviews, editorials, or proceedings (Table 2). Additional documents included 325 congress communications, 132 presentations, 51 technical reports, 14 PhD theses, 8 post-graduate dissertations, 4 books and 9 chapters, 18 lay press documents and 30 other documents. Although the number of reported articles is much higher in 1996 (due to 2 important projects with more than 20 publications), there are no big differences when comparing this numbers in the WOS database.

A total of 132 scientific publications as outputs from the Agency's call were found in the WOS database and these were cited 2,548 times up to early 2009 (2,231 excluding self-citations). Average number of citations per original article was 24.9. The 15 most highly cited publications (15%) of the sample received between 30 and 459 citations (excluding self-citations) (Table 2). A total of 29% of the authors' addresses of cited articles were from the USA or the UK, and only 9% from Spain.

Most articles (82%) were published in Spanish journals indexed in PubMed. Publications in English (17%) corresponded mostly to controlled trials, large cohort studies, systematic reviews, and analysis of the use of medical

devices (Garcia-Aymerich et al., 2001; Llovet et al., 2001; Martinez et al., 2003). Spanish articles focused mostly on local issues (outcomes studies, classification systems, translation and cultural adaptations of scales, and cost-effectiveness or budget impact analysis (Brotons et al., 2002; Permanyer et al., 2002; Conesa et al., 2003). The outreach of the call, measured in terms of percentage of international collaborations, was 15% (Conroy et al. 2003; Johnstone et al., 2005). Concerning the typology of journals, 24% of the scientific publications were issued in non-specialized peer-reviewed journals. A total of 40% of the original articles were published in journals with an impact factor >4.

The 10 issued calls of the NHS R&D HTA Programme (National Health Service Research & Development Health Technology Assessment programme) of England produced 263 peer-reviewed publications; with a remarkably short time-lag, the 3 editions of the Dutch HTA Program produced 101 peer-reviewed publications; and the 13 editions of the Hong Kong research program produced 377 peer-reviewed publications. All in all, the average of scientific publications per project was 2.3 for the Catalan call, 2.3 for the Dutch HTA Program, 2.9 for the NHS R&D Program, and 2.1 for the Hong Kong Health and Health Services Research Program.

The in-depth narrative analysis of an intentional sample of the highest impact and most frequently cited projects identified three clinical trials, four prospective cohort studies, one systematic review (including two meta-analyses), and one case-control study. The nine projects were all linked to major health problems. The two projects with the highest number of citations were a clinical trial and an observational study that filled an important local knowledge gap useful in clinical application. Eight projects were developed in large hospitals or research centres—except one, which was carried out in a primary care centre—and most were included in wider studies, thus resulting in some attribution concerns. Furthermore,



**Table 2.** Impact of the Agency's research projects ( $n = 92$ ) on advancing knowledge (Adam et al., 2010)

Agency calls	Analyzed projects/ Funded projects	Research activity						Research quality		Policy implications	
		Documents produced <sup>a</sup>		Scientific publications <sup>b</sup>		Original articles reported <sup>b</sup>		Original articles found in WOS			
		(n)	(Average per project)	(n)	(Average per project)	(n)	(Average per project)	(n)	Citations <sup>c</sup> to original articles found in WOS <sup>d</sup>		
	(n/n)							(n)	(Average per article)	Non-cited articles (%)	
1996	18/18	256	14.2	96	5.3	65	3.6	19	737	38.8	0
1998	15/19	112	7.5	40	2.7	27	1.8	24	634	26.4	8
2000	22/25	204	9.3	55	2.5	42	1.9	30	798	26.6	23
2002	23/25	142	6.2	42	1.8	28	1.2	16	302	18.9	25
2004	14/22	144	10.3	41	2.9	18	1.3	13	77	5.9	54
Total	92/109	858	9.3	274	2.3	180	2.0	102	2,548	24.9	20
Databases like the WOS might not capture a great part of locally relevant research in health services. Time span needed for identifying the full impact on advancing knowledge might take about 13 years.											

Note: <sup>a</sup>Includes documents published in scientific journals (editorials, original articles, systematic reviews, letters, proceeding papers, etc.) and other documents such as congress communications, technical reports, doctoral thesis, dissemination articles, presentations, book chapters, books, awards, grants reporting, etc.

<sup>b</sup>Only scientific publications and original articles are broken down.

<sup>c</sup>Includes self-citations.

<sup>d</sup>Search made in 2009.

a sizeable share of scientific articles ranking high in impact factor and citations were carried out in collaboration with groups from other parts of Spain or abroad.

### Assessment of the impact in decision-making

A total of 70 out of 99 PIs answered the study questionnaire (response rate: 71%) (Solans et al., 2010). Interviewees identified healthcare stake-holders as the main target audience of their research. The potential research use in the regional context of the CHS was predominantly (82%) for clinical and organizational areas (Table 3). Among those PIs who responded this question, 58% reported that a real impact had occurred in clinical practice. Yet, 30% of the PIs stated that to the best of their knowledge the results had not been taken into account subsequently. The highest translational action was carried out in science, academy, and practice.

A total of 15 relevant project researchers and 8 healthcare decision-makers (managers, medical directors, and heads of medical departments) from hospitals and primary care centres were interviewed. Table 4 summarizes the content analysis of the interviews (Adam et al., 2011a). Researchers usually gave greater importance to physicians than to healthcare policy-makers for changes in decision-making; in contrast, interactions between decision-makers and clinicians were viewed as positive.

Figure 1 shows the results of one project cited earlier in this article that studied the risk factors predisposing to acute exacerbation in patients with chronic obstructive pulmonary disease (COPD). The figure, which is not assumed to necessarily represent a finding applicable to other projects, shows a correspondence between the levels of impact and the phases of the logic model (advancing knowledge was not included in the mentioned study).

The differences between potential and real perceptions of informed decisions based on project results can be striking. Reported potential impacts not corresponding with real data referred to: (1) adoption relating to informed decision-making, and (2) health benefits and broad economic benefits.

### Discussion

This article illustrates how the assessment of the impact of research may close the research assessment cycle in a local agency for research funding and assessment and also suggests subsequent action plans. The cycle had begun with a call for topics, a priority-setting, and a selection of research topics. This was then followed by ex-ante and ongoing assessment processes. As a logical last step, the research required the analysis of the outputs and the impact assessment of the funded non-commercial clinical and health services research.

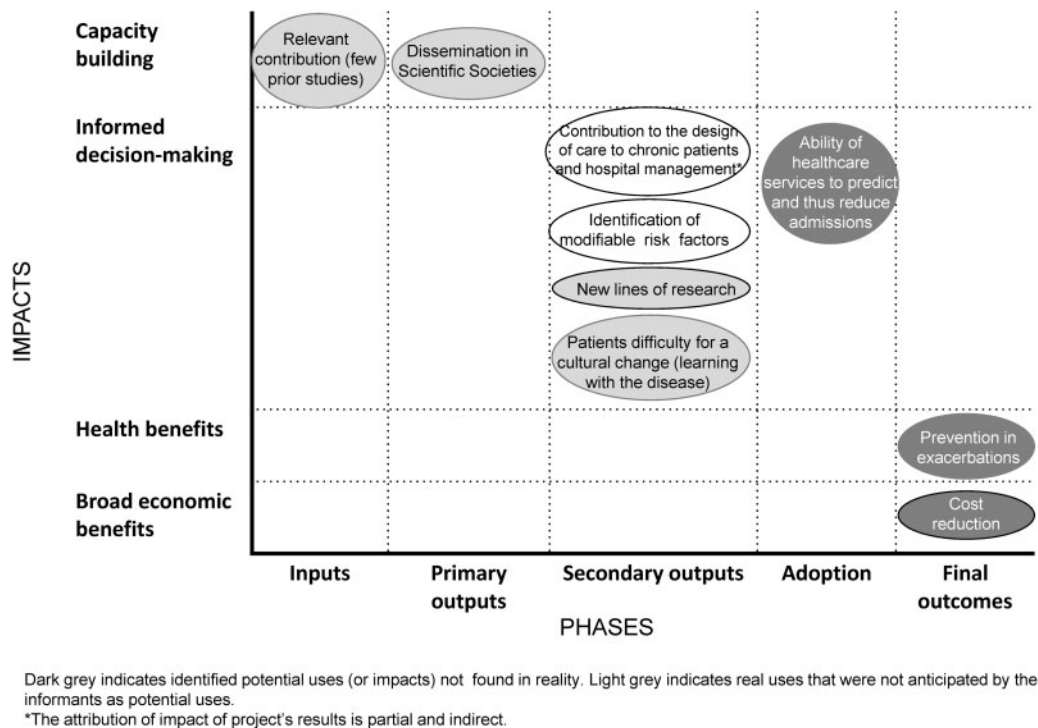
**Table 3.** Impact of the Agency's research projects on informed decision-making. Description of researcher responses to survey questions by categories ( $n = 70$ ) (Solans et al., 2010)

	( $n$ )	(%) <sup>a</sup>	Policy implications
<b>Translational actions carried out (<math>n = 57</math>)</b>			
Science, academy, and practice	57	85.1	Translational actions were taken in the academic, scientific or clinical practice areas.
Society and politics	8	11.9	
Market/industry	2	3.0	
<b>Potential targets or users of the results of the projects (<math>n = 46</math>)</b>			
Managers and policy makers	24	41.4	Research was oriented to reach clinical and health services' stakeholders, research community and scientific societies.
Health care professionals	17	29.3	
Researchers	12	20.7	
Scientific societies	5	8.6	
<b>Potential uses of research results (<math>n = 67</math>)</b>			
Clinical and organizational decision-making	38	44.2	Potentiality of results is very oriented to health services in all its different phases (from organization to technologies). Utility for further research is also mentioned.
Use of technologies	13	15.1	
Information for research	12	14.0	
Therapeutic innovations	11	12.8	
Diagnostic innovations	9	10.5	
<b>Changes induced by research results (<math>n = 40</math>)</b>			
Impact on clinical practice	29	58.0	Real changes were primarily behavioural (clinical and patient), and to a lesser extent changes in policy.
Organizational changes of the centre/institution	12	24.0	
Patient behaviour	5	10.0	
Public health management	2	4.0	
Legal/regulatory	2	4.0	

Note: <sup>a</sup>Some PIs identified multiple answers, therefore, percentages did not add up to 100.

**Table 4.** Impact of the Agency's research projects on informed decision-making: questions and responses provided by the researchers and the healthcare decision-makers ( $n = 23$ ) (Adam et al., 2011a)

Question	Evidence	Policy implications
<b>Potential use of research results</b>	Most investigators believed that the research performed had a potential use in clinical settings and/or in health services. Less mentioned were the potentiality in reducing healthcare costs and the generation of new knowledge for future research.	Some impacts might need to be assessed with longer time-lag.
<b>Real use of research results</b>	Most projects identified the generation of new research. Most researchers indicated changes in health services and/or in clinical practice (mostly indirectly attributed). A greater awareness of the clinical problem studied was also mentioned. Some researchers also identified healthcare costs reductions.	The impact on decision-making was identified mainly at intermediate levels of the logic model. Almost all projects had or might have induced changes in clinical practice or healthcare organization: few or many, direct or indirect, and having different degrees of attribution.
<b>Dissemination of knowledge</b>	It was carried out through conventional pathways such as scientific publications and clinical practice guidelines, but also through less explicit routes such as meetings with managers, or managers' direct collaboration in the project; scientific societies; websites; and often as apparently induced rather than formal or pre-established processes.	The channels used to transfer new knowledge to clinical practice are complex. Scientific societies and the formal or informal ties between researchers and local decision-makers can play a very important role.
<b>Decision makers who have influenced changes</b>	Researchers consider physicians to be the decision makers who have influenced the changes resulting from research the most and, to a lesser extent, clinical managers, planners and finally, the scientific community.	The awareness of the research team's professional environment, showed to be crucial, as well as the direct or indirect participation of healthcare and policy decision-makers in the projects. Interactions between researchers and decision-makers proved to be significantly fruitful.
<b>Barriers and facilitators</b>	The barriers and facilitators identified were organizational (coordination difficulties between levels of care, frequent rotation of managers), related with the nature of the research and with personal and cultural factors (such as reluctance to change, or the personal relationship between the decision-maker and the research team), and lack of resources.	Structural factors, such as the scarcity of transfer channels, insufficiently sensitive management structure, and the reluctance to change of the clinical community are some of the identified barriers.



**Figure 1.** Combination of views of different interviewees on the impact of the Agency's research projects on informing-decision making. Example of the results obtained for a COPD project on the risk factors predisposing to acute exacerbation, based on interviewees' responses.

Since 2008, the goal of the ISOR project has been to close the assessment loop of the research promoted by the Agency as its ultimate aim is to evaluate the social impact of such research. Up to now, evaluation studies have focused on the earlier phases of the construct underlying most of the Payback and ROI models. This study presents the results of the impact assessment of 'new' discoveries on advancing knowledge (i.e. filling knowledge gaps) and on informed decision-making (i.e. knowledge use). The strengths of the ISOR studies partly lie on the contextual novelty of the evidence in the field. The use of a variety of qualitative and quantitative methods and information sources brings multiple perspectives to the fuzzy area of 'research on research' and knowledge transfer. The methods, all based on a bottom-up assessment approach, are inspired in the ones used in the sizeable number of studies by the HERG Group from Brunel University and the RAND Europe team, lately integrated into the Project Retrosight (see [http://www.rand.org/pubs/working\\_papers/WR475.html](http://www.rand.org/pubs/working_papers/WR475.html)). Although both, internal and external validity of the results, have room for improvement, the findings presented in this article are a step forward in the literature, in line with three published peer-reviewed studies of similar calls. Further comparisons with results published in grey literature might shed more light into the tentative conclusions raised here.

The choice of the ROI conceptual model fitted the purposes of the ISOR project promoted by the Agency by identifying the different types of interaction routes or pathways from knowledge creation to knowledge use, although particular aspects need to be adapted to the local context. For instance, the grouped sectors where decisions are taken in the model include 'health industry', a much too generic group for assessing applied biomedical research such as healthcare services. Further disaggregation of the model by type of health-related activity (healthcare by level, market for devices and pharmaceuticals, diagnostic, prevention, etc.) would be appropriate for assessing T2 translational research oriented calls such as the one promoted by the Agency. Here the conceptualization of Tassey (2008) might be useful, that differs between a transference to market (property technologies) and a transference to clinical/healthcare services (through clinical practice guidelines, protocols, or 'infratechnologies'). Glances of possible disaggregation might as well be obtained from the categorizations of interviewees responses to semi-structured questionnaires of the case study.

Results obtained by using either the ROI Model or Payback Model proved to be comparable, with the necessary reallocation of categorizations and contextual caveats. One difference concerns the definition of impact levels and thus the categorization of impacts. The results

using the Payback Model, for example, distinguish between behavioural changes and policy changes, while the ROI puts both changes together while disaggregating by levels and contexts of decision-making.

Regarding the assessment of advances in knowledge, the study is not free of the classic challenges of research impact assessment studies such as attribution, counter-factual, and censored time window (Panel on the return on investments in health research, 2010). Scientific outputs were attributed to the Agency's funded projects based upon authors self-reporting (either through the questionnaire or acknowledgments in the publications) with all of the limitations of self-report. Yet, the limits of attribution are sometimes difficult to set. Self-reported co-funding (21% of the projects) are a means to estimate research outputs that might have been produced anyway without the support of the Agency. As for identified outputs, biases can in fact occur, which can lead to overestimations (due to suspiciously or indirectly attributed outcomes) and underestimations (unobserved censored outputs, not captured within the time frame of the analysis). While the time frame proved to be close to the optimum length for the 1996 call (~13 years), the study was certainly right-hand-side censored for subsequent calls. Another limitation of the study was the no inclusion of locally oriented journals in the WOS database.

The diversity of project topics sets a limitation to any simple measure of the average number of citations in relation to a Spanish or international rate. However, there is no doubt that some original articles from projects granted in the Agency's call reached a considerable scientific impact, as measured and confirmed by the number of citations or the journal impact factors where they were published. International collaboration appears to favour greater impact (Figg et al., 2006).

Likewise, one should bear in mind that health sciences research production in Spain is broader than what is collected in the WOS database. For instance, from the 320 medical journals included in the IME, only 44 are in Pubmed (Medline database), and 14 in the WOS (Figueredo-Gaspari 2005). As a whole, the Agency funded research on a fairly large number of topics for which local stake-holders identified a knowledge gap (from 64% to 88% of the selected topics). ISOR studies on the advancement of knowledge have permitted quantitative assessment of its volume and quality, and provided a basis for comparison with other contexts and further developments of local research.

Using the payback characterization, the results from the Agency study suggest that a broad 70% of the induced changes were through modified behaviours (e.g. clinical practitioners and patients) rather than through informing policy. This contrasts with the case of the England's NHS R&D HTA program, where 73% of the projects had impact in policy against 42% behavioural changes (e.g. clinicians, patients, and researchers). Maybe the reason

could be that in the case of the NHS R&D HTA program, topics are selected with a top-down approach, although they are prioritized. In Hong Kong, patterns seem to look more like the Catalan case.

The case study methodology applied to a sample of projects on respiratory diseases identified some features of the pathways of knowledge translation in practice that have policy implications. For instance, opinion endorsement by local scientific societies as authoritative sources seems to be relevant for dissemination of new concepts in some contexts. This suggests that a more complex route of information flows than is contemplated in previous conceptualizations. The same can be said about person-to-person communication in some contexts. The opinions of individual professionals based on research results are deemed by most researchers in the study to be more strongly associated with changes in clinical decision-making than the directions given by healthcare policy makers. These are usually ignored by researchers in the study; however, in those instances where decision makers and clinicians have worked together about the results of research knowledge application in practice, the collaboration has been highly satisfactory. The external validity of this type of findings is to be assessed; nevertheless, it suggests pathways for further exploration. A gap between potential impacts and real impacts was found, probably because interviewees were not aware of the impact itself or because they often confused potential impact with the study's objective.

In general, cross-country comparisons with previous international studies, if made with caution, are illustrative. For instance, the outreach of the calls, measured in terms of percentage of international collaborations (15% of the Agency's projects, and 27% for the full biomedicine scientific production in the Catalan region) is also associated with higher impacts (in advancing knowledge), in line with studies conducted elsewhere (Adam et al., 2011b). In qualitative terms, the association of the engagement of researchers and practitioners with higher impacts appears to be a robust cross-country result.

The study of impact on decision-making is not free of the usual limitations of this type of study (attribution, time-lag, counter-factual, etc.) and pathways to impact upon are more complicated to discern. This is partly because the sample selection method had weaknesses, since it was a reduced intentional sample, compared with parallel international cross-country studies (Wooding et al., 2011) using a stratified random sample of a large number of case studies.

The impact assessments and the dissemination of results in different ways have helped inform policy makers in Catalonia and future plans in different ways. First, it was a tool for advocating for public funding of T2 research type, specifically from the department that runs and plans the health system. Second, it brought a number of arguments that allowed accountability discussions and



exercises to take place. Third, lessons were learned and proposed for further editions of the Agency calls. Finally, a future strategy was designed and proposed (Solans et al., 2012).

## Conclusions

Local agencies can significantly contribute to fill the gap of local knowledge needs. Assessment of the full research cycle provides opportunities for improving the entire research process (identification of knowledge gaps, call for proposals, funding allocation, research completion, subsequent impact). Specifically, assessment of the different types of impact of research development on knowledge generation and decision making closes the evaluation cycle for fulfilling the Agency's mission.

In our context, the ISOR studies promoted by the Agency set the ground for further contextual examinations and discussions, highlighting the social gains of investment in research and the translation/application of knowledge. The results of the different ISOR studies provide reasons to advocate for oriented research to fill specific knowledge gaps and show cases of informed behavioural changes of some stakeholders based on this new knowledge. Moreover, the results provide accountable data to report on the accomplishments of the Agency's extramural research program, and they offer useful lessons for refining the future research agenda. Finally, they show the need to promote researcher awareness regarding the importance of translation or application of results. Therefore, the evaluation of the impact of research on knowledge generation and decision making at the local health care level has provided insights that may be relevant for purposes in wider contexts and should thus be further developed.

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## Notes

1. Until June 2010, the Agency was known as Catalan Agency for Health Technology Assessment and Research (CAHTA). This has now changed to Catalan Agency for Health Information, Assessment and Quality (CAHIAQ).

## References

- Adam, P. et al. (2011a) *Impact of Clinical and Health Services Research Projects on Decision-Making. A Qualitative Case Study*. Barcelona: Catalan Agency for Health Information, Assessment and Quality, Catalan Health Service, Department of Health, Generalitat de Catalunya: 2011.
- . (2011b) *L'impacte social de la recerca biomèdica a Catalunya*. Nota d'Economia, Departament d'Economia i Finances, Generalitat de Catalunya, vol. 97–98, pp. 127–53.
- . (2010) *Impact of Clinical and Health Services Research on Advancing Knowledge. Study Applied to the CAHTA's Research Calls*. 3rd edn. Barcelona: Catalan Health Service, Department of Health, Government of Catalonia.
- Berra, S. et al. (2010) 'Setting priorities in clinical and health services research: properties of an adapted and updated method'. *International Journal of Technology Assessment in Health Care*, 26/2: 217–24.
- Brotons, C. et al. (2002) 'La influencia de los métodos de presentación de los resultados en ensayos clínicos sobre la eficacia de una intervención y la intención de prescribir fármacos para la prevención cardiovascular', *Revista Española de Cardiología*, 55/10: 1042–51.
- Carmichael, M. and Begley, S. (2011) *Desperately Seeking Cures*, [web on Internet] (New York, US: Newsweek Magazine, 2010) <[www.newsweek.com/2010/05/15/desperately-seeking-cures.html](http://www.newsweek.com/2010/05/15/desperately-seeking-cures.html)> last accessed 13 September 2011.
- Conesa, A. et al. (2003) 'Evaluación de los informes de asistencia de urgencias como instrumento de gestión de la información clínica', *Medicina Clínica (Barcelona)*, 120/19: 734–6.
- Conroy, R. M. et al. (2003) 'Estimation of ten-year risk of fatal cardiovascular disease in Europe: the SCORE project', *European Heart Journal*, 24/11: 987–1003.
- Dorsey, E. R. et al. (2010) 'Funding of US biomedical research, 2003–2008', *The Journal of the American Medical Association*, 303/2: 137–43.
- European Science Foundation. (2011) *Implementation of Medical Research in Clinical Practice*. Strasbourg cedex, France: European Science Foundation.
- Figg, W. D. et al. (2006) 'Scientific collaboration results in higher citation rates of published articles', *Pharmacotherapy*, 26/6: 759–67.
- Figueredo-Gaspari, E. (2005) 'Valoración curricular de las publicaciones científicas', *Medicina Clínica (Barcelona)*, 125/17: 661–5.
- Frank, C. and Nason, E. (2009) 'Health research: measuring the social, health and economic benefits', *Canadian Medical Association Journal*, 180/5: 528–34.
- García-Armesto, S. et al. (2010) 'Health System Review. Brussels (Belgium): Health Systems in Transition', *European Observatory on Health Systems and Policies*, 4: 1–295.
- García-Aymerich, J. et al. (2001) 'Risk Factors for Hospitalization for a Chronic Obstructive Pulmonary Disease Exacerbation. EFRAM Study', *American Journal of Respiratory and Critical Care Medicine*, 164/6: 1002–7.

- Hanney, S. et al. (2007) 'An assessment of the impact of the NHS Health Technology Assessment Programme', *Health Technology Assessment*, 11/53: iii–xi, 1.
- Hanney, S. R. et al. (2004) 'Proposed Methods for Reviewing the Outcomes of Health Research: The Impact of Funding by the UK's 'Arthritis Research Campaign'', *Health Research Policy and Systems*, 2/1: 4.
- Johnstone, C. N. et al. (2005) 'PRR5 Encodes a Conserved Proline-Rich Protein Predominant in Kidney: Analysis of Genomic Organization, Expression, and Mutation Status in Breast and Colorectal Carcinomas', *Genomics*, 85/3: 338–51.
- Kwan, P. et al. (2007) 'A Systematic Evaluation of Payback of Publicly Funded Health and Health Services Research in Hong Kong', *BMC Health Services Research*, 7: 121.
- Llovet, J. M. et al. (2001) 'Increased Risk of Tumor Seeding After Percutaneous Radiofrequency Ablation for Single Hepatocellular Carcinoma', *Hepatology*, 33/5: 1124–9.
- Martinez, E. et al. (2003) 'Substitution of Nevirapine, Efavirenz, or Abacavir for Protease Inhibitors in Patients with Human Immunodeficiency Virus Infection', *The New England Journal of Medicine*, 349/11: 1036–46.
- Montague, S. and Porteous, N. L. (2012) 'The Case for Including Reach as a Key Element of Program Theory', *Evaluation and Program Planning* (in press) [Epub ahead of print].
- Moses, H. and Martin, J. B. (2011) 'Biomedical Research and Health Advances', *The New England Journal of Medicine*, 10/364: 567–71.
- OECD. (2010) *OECD Reviews of Regional Innovation: Catalonia, Spain 2010*. Paris, France: Organisation for Economic Co-Operation and Development (OECD).
- Oortwijn, W. J. et al. (2008) 'Assessing the Impact of Health Technology Assessment in The Netherlands', *International Journal of Technology Assessment in Health Care*, 24/3: 259–69.
- Panel on the return on investments in health research. (2010) *Making and Impact. A preferred Framework and Indicators to Measure Returns on Investment in Health Research*, (Ottawa, Canada: Canadian Academy of Health Science (CAHS), 2009) <www.afmc.ca/pdf/ROI\_FullReport.pdf> last accessed 13 September 2011.
- Permanyer, M. G. et al. (2002) 'Características basales y determinantes de la evolución en pacientes ingresados por insuficiencia cardiaca en un hospital general', *Revista Española de Cardiología*, 55/6: 571–8.
- Raftery, J. et al. (2009) 'Assessing the Impact of England's National Health Service R&D Health Technology Assessment Program Using the "Payback" Approach', *International Journal of Technology Assessment in Health Care*, 25/1: 1–5.
- Solà-Morales, O. and Granados, A. (2009) 'Health Technology Assessment in Catalonia: An Overview of Past and Future Perspectives', *International Journal of Technology Assessment in Health Care*, 25(Suppl. 1), 88–93.
- Solans, M. et al. (2010) *Impacte de les convocatòries de recerca clínica i en serveis sanitaris en la presa de decisions informades i la capacitat. Visió dels investigadors*. Barcelona: Agència d'Informació, Avaluació i Qualitat en Salut, Departament de Salut, Generalitat de Catalunya.
- . (2012) *Past, present and future*. Barcelona: Agència d'Informació, Avaluació i Qualitat en Salut, Departament de Salut, Generalitat de Catalunya.
- Tassey, G. (2008) *The Roles and Economic Impacts of Technology Infrastructure. Version 3*. Gaithersburg, MD: National Institute of Standards and Technology.
- Wooding, S. et al. (2011) *Project Retrosight. Understanding the Returns from Cardiovascular and Stroke Research, The Policy Report* (Cambridge, UK: RAND Europe) <www.rand.org/pubs/monographs/MG-1079-RS> last accessed 13 September 2011.
- Woolf, S. H. (2008) 'The Meaning of Translational Research and Why It Matters', *The Journal of the American Medical Association*, 299/2: 211–3.